



BOSCH

Installation Manual

for Bosch Solar Energy 72-cell Photovoltaic Modules

c-Si P 72 NA21126 | c-Si M 72 NA41126



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1.0 INTRODUCTION

The purpose of this guide is to provide general information regarding the proper installation and handling of Bosch Solar Energy photovoltaic modules that serve residential, commercial, and industrial segments. System design, construction, and commissioning should be performed by qualified personnel only.

To ensure system integrity, designers, installers and operators must meet all mechanical and electrical requirements for the system and its components. It is the responsibility of the system designer and installer to ensure that all codes and requirements are followed as well.

Please review all the sections that pertain to proper installation of modules listed in this Guide. The instructions detailed in this guide must be followed throughout the module's lifetime deployment. If you need additional information about the safe, proper use and handling of Bosch photovoltaic module products, please contact Bosch Solar Energy.

2.0 PHOTOVOLTAIC MODULES PRODUCT CODE

c-Si P 72 NA21126 Multi-crystalline Modules	280 Wp	285 Wp	290 Wp	295 Wp
c-Si M 72 NA41126 Mono-crystalline Modules	290 Wp	295 Wp	300 Wp	305 Wp

3.0 MODULE OVERVIEW

Bosch Solar Energy Photovoltaic modules consist of a series of electrically interconnected crystalline silicon solar cells that are sealed within a laminated sheet of tempered glass superstrate* and EVA/back-sheet substrate. These laminates are secured inside an aluminum frame to provide rigidity and a means for attachment to mounting sub-structures. The frames should not be modified or removed. * *Tempered glass may have AR coating.*

- Photovoltaic modules are designed and constructed for outdoor use. Do not submerge modules in water at any time.
- The front and back of each module is labeled with a product bar code. Do not cover, remove or deface these labels. This may be required for product identification.
- Damage to the glass surface or the anti-reflective coating can impact the power output and overall efficiency of the system. Scratches, handling marks, or any damage to the glass surface must be avoided.
- For best performance and to avoid potential issues, keep the front side of the module clean and free of obstructions including covers, tape, adhesives, paint and debris.

3.1 MAINTENANCE

Check modules, glass, and frames for damage. Regularly inspect all Bosch Solar Modules for safe electrical connections, sound mechanical connections, and freedom from shading and corrosion. If dirt or debris buildup becomes excessive, periodically clean the glass only with a soft cloth using mild, non-abrasive detergent and water. When using mild cleaning liquids, a neutral pH in the range of 6.0 to 8.0 is recommended. Chemicals with pH less than 6.0 or greater than 8.0 should be avoided as it may damage the glass surface and or the AR coating. Please consult with system designer to decide the cleaning and inspection frequency according to local environmental conditions.

Do not power wash or use harsh cleaning materials or objects such as scouring powder, steel wool, scrapers, blades, or other sharp instruments to clean the glass surface of the module. Use of such materials will invalidate the product warranty.

WARNING: Use caution when cleaning the back surface of the module to avoid penetrating the substrate materials.

3.2 STORAGE, UNPACKING, AND HANDLING

- Packaged modules must be stored in a dry and ventilated area.
- Packaged modules must not be exposed to rain, snow, hail or other environmental conditions that may compromise the packaging material and the modules.
- Packaged modules must be on appropriate provided pallets and must not be stacked more than two pallet high for storage.
- Once the modules are opened, store modules in a dry and ventilated room.
- Modules should never be stored in a wet environment.
- Upon unpacking, do not carry a module by its wires or junction box. Only carry a module by its frame with two or more people.
- Precaution should be taken to avoid damage to the glass surface with or without anti-reflective coating due to improper handling during storage or unpacking.
- Keep all electrical contacts clean and dry.
- All modules are manufactured with a sealed junction box and pre-attached cables and locking connectors. These components should not be modified or tampered with in any way.
- Do not allow unauthorized persons near the installation site or storage area of modules.
- Do not place modules on top of one another.
- Do not place any load on the module or twist the module frame.
- Do not stand, step, walk, or jump on the module.
- Do not drop or place objects on the modules such as tools.
- Do not handle modules with bare hands and avoid scratches, handling marks, or any damage especially to the front glass of the module, backsheet, or electrical components.
- Do not mark the modules with sharp instruments.
- Do not leave a module unsupported or unsecured.
- Do not modify module frames in any way.

3.3 SAFETY

The following safety guidelines and best practices should be followed:

- All installations must be performed in compliance with all applicable regional and local electrical codes or other national or international electrical standards.
- Use insulated tools during installation, troubleshooting and maintenance of photovoltaic modules.
- Wear suitable protection to prevent direct contact with module's electrical output and mechanical sharp edges.
- Cover the front of the modules with an opaque material to stop production of electricity when installing or working with a module or wiring.
- Modules connected in a series should not be disconnected under illumination. Disconnecting modules under illumination may cause electrical arcing which may result in burns, fires or other problems.
- Follow industry best practices when commissioning, trouble shooting, disconnecting, or connecting a PV system.
- Trouble shooting should include planning, checking, disconnecting, cause seeking, replacement, and record keeping.
- Do not install or handle the modules or their components when they are wet or during periods of high wind.
- Do not attempt to disassemble, repair, or open any part of the module including junction box or sub-components.
- Do not artificially concentrate sunlight on a module.
- Do not install or handle any broken modules. If a module is broken, or the back sheet is torn, contact with the surface or frame can cause an electrical shock.
- Do not wear rings, jewelry, watches, or other metallic items while working with photovoltaic modules.

4.0 MECHANICAL INSTALLATION

4.1 PLANNING AND DESIGN

- Before installation, check to ensure all sub-structure will accommodate expected system loads. This includes but is not limited to roof, foundations, mechanical structure, and mechanical connections.
- For roof installations, utilize a fire-resistant roof covering rated for the application.
- Mechanical structures should not contact the module backsheet under any expected load conditions
- Consider the following factors during system design, which will influence performance:
 - a) Bosch solar modules produce the most power when they are pointed directly at the sun, and should be tilted for optimum system performance.
 - b) Proximity to obstructions such as: walls, buildings, trees, groundcover, snow cover, or dust and debris that have the potential to shade or damage the modules.
 - c) Elevated temperatures will decrease energy yield, so designs should ensure adequate airflow across the back of the module.
 - d) Allow a minimum spacing of 10 mm between modules for thermal expansion.

4.2 MODULE INSTALLATION OPTIONS FOR MOUNTING LOCATIONS

For mounting locations for clamps or bolt for specified load, please refer to Table on page 5.

- Each module should be mounted using four bolts through the mounting holes on the rear side of the module, or with four clamps over the front side.
- Depending on the desired load capability of the array, modules may be mounted either perpendicular or parallel to the structure rails. Clamps can be mounted anywhere inside of the safe mounting range for each case illustrated below (referring to chart showing clamp and bolt mounting locations).
- If using bolts, four mounting holes are provided on the rear side the module frame as shown in Appendix 8.1. Use a stainless steel bolt stack no smaller than ¼"-20 or M6, with two flat washers and a locking washer as shown in Appendix 8.2.
- To ensure an adequate clamping area, all clamps used must comply with the minimum clamping dimensions specified in Appendix 8.3. All fasteners used to fix the modules with clamps should be stainless steel, and no smaller than ¼"-20 or M6.
- To provide adequate fixing or clamping force, torque the minimum recommended fasteners to 13.6 - 16.3 N·m [10 - 12 ft lb].
- For all cases, the area of the supporting structure in contact with rear side of the module must comply with the minimum support dimensions specified in Appendix 8.3.
- All other structural dimensions, such as clamp and rail thickness, should be sized appropriately for the intended site load.

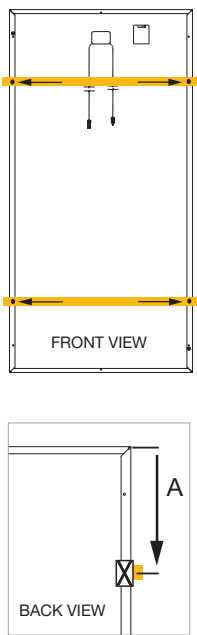
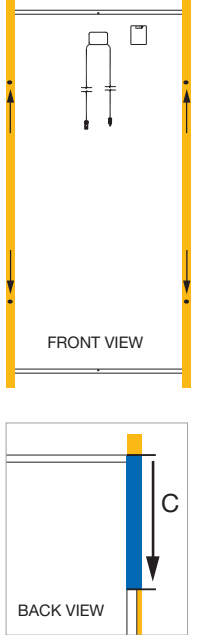
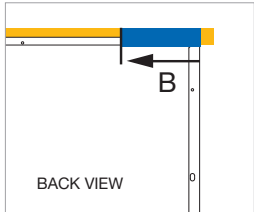
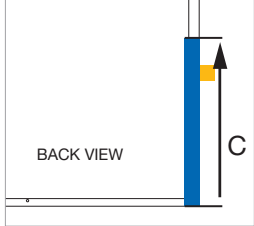
4.3 MODULE INSTALLATION USING CENTER MOUNTING BRACKETS

- Modules may also be mounted using center clamps as shown in Appendix 8.2, for use with trackers.
- Module clamps for center mounting must be based on Bosch Solar Energy approved extrusion and hardware.
- For module loads higher than 2400 Pa, module clamps and hardware must be pre-approved by Bosch Solar Energy.

4.4 MECHANICAL INSTALLATION WARNINGS

- Installation and maintenance should be performed by qualified personnel only.
- Use insulated tools during installation, troubleshooting and maintenance of photovoltaic modules.
- Installers should adhere to all applicable local, regional, and national codes and regulations when designing and constructing the photovoltaic system.
- Do not stand or walk on any surface of the modules. Do not place any objects or load on the surface of the modules.
- Precaution should be taken to avoid damage to the glass surface with anti-reflective coating due to improper handling during installation.
- Mechanical structures should not contact the module backsheet under any expected load conditions.

- Additional mounting holes may not be drilled in the frame, glass or backsheet.
- Ensure that frame weep holes (see Appendix 8.1) are not obstructed by the mechanical installation.

MOUNTING CONFIGURATIONS						
	CASE 1		CASE 2		CASE 3	
MODULE ILLUSTRATION	 Bolt Mount Locations Clamp Mount Locations: Fixed clamp location for 5400 Pa front load		 Bolt Mount Locations Clamp Mount Locations: Clamp mount allowable range		Clamp Mount Locations: Clamp mount allowable range Case 3, option 1  OR Case 3, option 2 	
LOAD PARAMETERS	Maximum Rear Load:	Maximum Front Load:	Maximum Rear Load:	Maximum Front Load:	Maximum Rear Load:	Maximum Front Load:
	2400 Pa or 50 psi	5400 Pa or 113 psi	2400 Pa or 50 psi	5400 Pa or 113 psi	2400 Pa or 50 psi	2400 Pa or 50 psi
DETAILS	CASE 1: Structural rails running perpendicular to the length of the module should be fixed via bolts at the mounting holes between each long side frame, or Clamps can be mounted at the Fixed Clamp Mount location as shown in the color code key.		CASE 2: Structural rails running parallel to the length of the module should be fixed via bolts at the mounting holes on each long side frame, or Clamps can be mounted anywhere within the Clamp Mount Range as shown in the color code key.		CASE 3: Structural rails running perpendicular to the length of the module should be fixed via bolts at the mounting holes between each long side frame, or Clamps can be mounted anywhere within the Clamp Mount Range as shown in the color code key.	

Mounting Color Code: ● Mounting Hole Location ■ Module Rail ☒ Fixed Clamp Mount ■ Clamp Mount Range

Fixed Clamp Mount location: A – 394 mm
Clamp mount allowable range: B – 248 mm
C – 444 mm

5.0 ELECTRICAL INSTALLATION

5.1 PLANNING AND DESIGN

- All modules are manufactured with a sealed junction box and pre-attached cables and locking connectors. These components should not be modified or tampered with in any way.

NOTE: Installers should ensure that the polarized locking connectors are from the same supplier when connected on the same string. We do not recommend mixing polarized interlocking connectors from different manufacturers—including connections at the inverter, combiner boxes, and modules.

- Ensure connectors are clean and dry before establishing connection.
- Ensure that all wire, fusing and disconnects are appropriately sized for the system design according to national, regional, and local codes.
- Electrical characteristics are within plus or minus 5% of rated values for I_{sc} , V_{oc} , I_{mpp} and V_{mp} . P_{max} ranges between -0/+5W at standard test conditions (STC). However, modules will operate under conditions which may be significantly different than STC. Bosch Solar Energy suggests multiplying specified ratings by a minimum of 1.25 or more when specifying the system and balance of system components. Refer to local codes before planning and design of the system.
- Determine the maximum number of modules connected in series using the following formula: $N_s = V_{max_s} / V_{oc_m}$

Where:

N_s equals the maximum modules in series

V_{max_s} equals the maximum system voltage:

please refer to module data sheet for actual V_{max} rating, as some models are rated for 1000 V UL and 1000 V IEC.

V_{oc_m} equals the module open circuit voltage at coldest conditions for the site (refer to local codes)

WARNING: Installers should adhere to all applicable local, regional, and national codes and regulations when designing and constructing the photovoltaic system.

NOTE: In colder climates, it may be necessary to further reduce the maximum number of modules in series by using V_{oc_m} at the minimum expected operating temperature.

5.2 MODULE WIRING

- The module includes wires and polarized locking connectors from the junction box on the back of the module. The wires have sufficient length to connect to adjacent modules in either a portrait or landscape configuration. Field replacement of connectors or cables must be avoided and it will invalidate the product warranty. Polarized locking connectors of the same type and make are needed for all series string wiring. The maximum operating temperature of wires and connectors should not exceed 85°C.

WARNING: It is not recommended to mix connectors from different suppliers within the same string. This includes connections at the inverter, combiner boxes, and modules.

- Always wire modules so that proper polarity is maintained. Avoid placing excessive tension on the cables.
- There is no limit to the maximum number of series strings that can be combined in parallel. However, when doing so, each string must include overcurrent protection with a maximum rating of 15A. Bosch Solar Energy recommends the use of DC rated fuses or overcurrent protection devices with the appropriate maximum voltage rating.
- Do not connect modules directly to a parallel bus.
- The cross-sectional area of cable and the connector type must be selected to align with the overall system design and should include the maximum short circuit current of the system, maximum operating temperatures, and cable run lengths.
- For field connections, use at a minimum #12 AWG/4 mm² wires insulated for a minimum of 85°C. Use copper wire only.

5.3 GROUNDING

- The module frame includes several labeled grounding holes. These holes may not be used for any other purpose.
- Bosch Solar Energy recommends a Burndy BGBL-4 AL lay-in lug for grounding.
- Only Negative grounding circuits (negative polarity to ground) shall be used within the array design.
- Attach the grounding lug to the frame as follows:

Step 1: Use stainless steel hardware.

Step 2: Place the grounding lug over the grounding hole on the exterior of the module frame.

Step 3: Place a star washer directly between the bottom of the grounding lug and the exterior surface of the frame.

Step 4: Place an M4 or #8-32 bolt through the lug, star washer and frame grounding hole.

Step 5: Secure the lug to the frame using a flat washer, split washer and M4 or #8-32 nut.

Step 6: Torque the bolt stack to approximately 1.5 Newton-meters (or 1.1 foot pounds) to ensure the star washer scratches the anodized frame.

It should be noted that the Bosch 72 cell module frame profile has been evaluated for compatibility with the Daetwyler Clean Energy Modu-Rack, High-Top and Eco-Top mounting frame structure grounding systems. Please refer to the Max Daetwyler Corporation Listing Constructional Data Report no. 100618390LAX-002 from Intertek Testing Services NA.

5.4 ELECTRICAL INSTALLATION WARNINGS

- Installation and maintenance should be performed by qualified personnel only.
- Use insulated tools during installation, troubleshooting and maintenance of photovoltaic modules.
- Installers should adhere to all applicable local, regional, and national codes and regulations when designing and constructing the photovoltaic system.
- Photovoltaic modules produce DC electrical energy from light. When illuminated, each module can have a DC potential of greater than 45 V and should be handled with care.
- Disconnecting modules under illumination may cause electrical arcing which may result in burns, fires, or other problems. Modules connected in series should not be disconnected under illumination.
- Always use a wire management system that keeps wires and cables out of direct contact with edge surfaces which could cut or damage the insulation. Do not allow wires to rest on the ground or roof surface.
- The module junction box should not be opened or modified in any way in the field.
- Additional grounding holes may be added only with the express written consent of Bosch Solar Energy. New grounding holes must be drilled using an approved drill jig, avoiding damage to the module glass, backsheets, or other module components.

- Do not use mirrors, lenses, or other techniques to magnify or concentrate additional light on the module.

6.0 DISCLAIMER OF LIABILITY

The information in this manual is based on Bosch Solar Energy's knowledge and experience and is believed to be accurate. However, all information in this manual (without exception) including recommendations and specifications does not constitute a warranty, expressed or implied. Bosch reserves the right to change the manual, the module, or specifications without prior notice.

The product warranty shall be VOID if handling and installation of the product does not conform to Bosch Solar Energy's written installation instructions, or if the product has been reworked, repaired or otherwise modified in a manner not previously authorized by Bosch Solar Energy in writing, or if the product is installed in an environment for which it was not designed. Bosch Solar Energy shall not be liable for special, indirect, consequential, contingent or incidental damages related to or arising from the installation or use of the product by purchaser under any circumstances.

Bosch Solar Energy assumes no responsibility for any product application or use which is beyond Bosch Solar Energy's direct control. Bosch Solar Energy does not accept responsibility and expressly disclaims liability for loss, damage, or expense arising out of or in any way connected to such installation, operation or maintenance of the product.

International Product Certifications:

UL 1703 and Safety Class II certifications ensure that Bosch solar products operate safely and comply with global electrical,

Certification	• Stringent outgoing quality acceptance criteria benchmarked to industry standards • UL1703 listed by CSA for Canada and US
Environmental	AB8 (-50°C to +40°C)
Fire Resistance Rating	Class C

Bosch Solar Energy Modules are certified by:



7.0 MECHANICAL AND ELECTRICAL PARAMETERS AND SPECIFICATIONS

7.1 c-Si P 72 MODULE DETAILS

c-Si P 72 NA21126 Multi-crystalline Modules	280 Wp	285 Wp	290 Wp	295 Wp
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TEMPERATURE COEFFICIENTS AND PARAMETERS

Nominal Operating Cell Temperature (NOCT) (°C)	47 ± 2
Temperature Coefficient of P _{max} (%/°C)	-0.45
Temperature Coefficient of V _{oc} (%/°C)	-0.33
Temperature Coefficient of I _{sc} (%/°C)	+0.066
Operating Temperature (°C)	-40 to +85
Maximum System Voltage (V)	1000 (UL & IEC)
Limiting Reverse Current (A)	8.40
Maximum Series Fuse Rating (A)	15
Power Range (W)	-0/+5

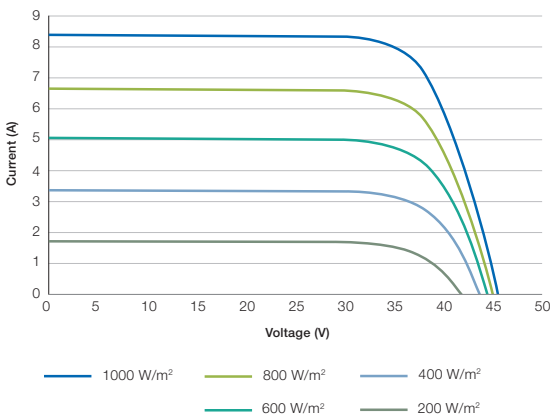
Temperature coefficients may vary by ±10%

ELECTRICAL CHARACTERISTICS

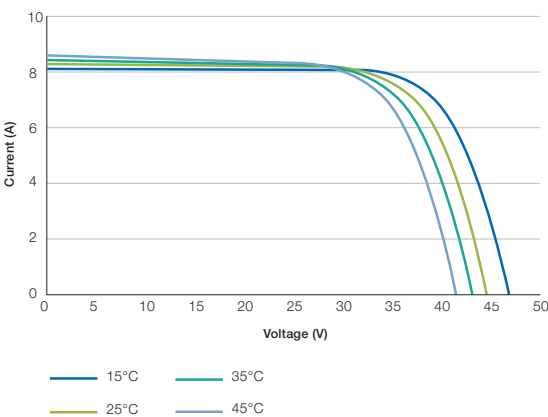
Model #	280 Wp	285 Wp	290 Wp	295 Wp
Rated Maximum Power P _{max} (W)	280	285	290	295
Open-Circuit Voltage V _{oc} (V)	44.0	44.4	44.7	45.1
Short Circuit Current I _{sc} (A)	8.60	8.65	8.71	8.95
Module Efficiency (%)	14.3	14.6	14.8	15.1
Maximum Power Point Voltage V _{mpp} (V)	34.7	35.0	35.4	35.3
Maximum Power Point Current I _{mp} (A)	8.08	8.16	8.20	8.36

All electrical data at STC: 1000W/m², AM1.5, 25°C
Electrical characteristics measurement tolerance is ±5% and power is -0/+5W

IV CURVES AT MULTIPLE IRRADIANCES [25°C]



IV CURVES AT MULTIPLE TEMPERATURES [1000 W/m²]



7.0 MECHANICAL AND ELECTRICAL PARAMETERS AND SPECIFICATIONS

7.1 c-Si M 72 MODULE DETAILS

c-Si M 72 NA41126 Mono-crystalline Modules	290 Wp	295 Wp	300 Wp	305 Wp
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TEMPERATURE COEFFICIENTS AND PARAMETERS

Nominal Operating Cell Temperature (NOCT) (°C)	46 ± 2
Temperature Coefficient of P _{max} (%/°C)	-0.45
Temperature Coefficient of V _{oc} (%/°C)	-0.34
Temperature Coefficient of I _{sc} (%/°C)	0.035
Operating Temperature (°C)	-40 to +85
Maximum System Voltage (V)	1000 (UL & IEC)
Limiting Reverse Current (A)	9.10
Maximum Series Fuse Rating (A)	15
Power Range (W)	-0/+5

Temperature coefficients may vary by ±10%

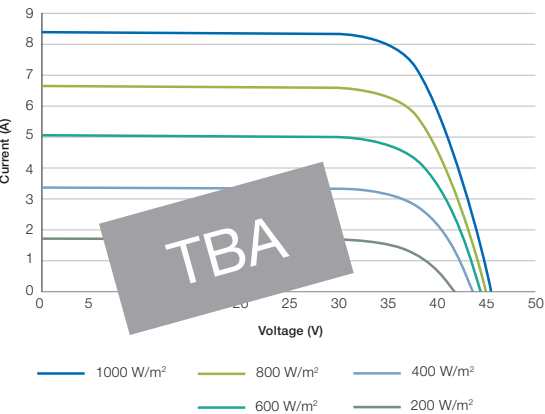
ELECTRICAL CHARACTERISTICS

Model #	290 Wp	295 Wp	300 Wp	305 Wp
Rated Maximum Power P _{max} (W)	290	295	300	305
Open-Circuit Voltage V _{oc} (V)	45.0	45.2	45.6	45.8
Short Circuit Current I _{sc} (A)	8.70	8.80	8.90	9.00
Module Efficiency (%)	14.9	15.1	15.3	15.6
Maximum Power Point Voltage V _{mpp} (V)	36.2	36.4	36.6	36.8
Maximum Power Point Current I _{mp} (A)	8.01	8.10	8.20	8.29

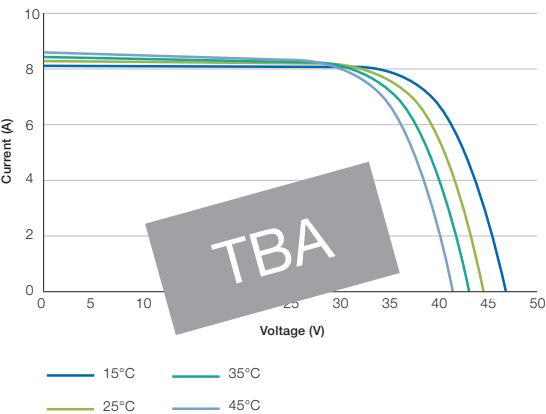
All electrical data at standard test conditions (STC): 1000W/m2, AM1.5, 25°C
Electrical characteristics may vary by ±5% and power by -0/+5W

* Listed specifications are subject to change without prior notice.

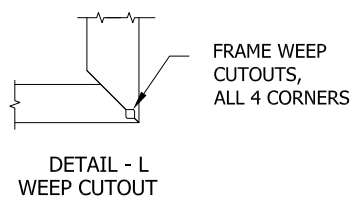
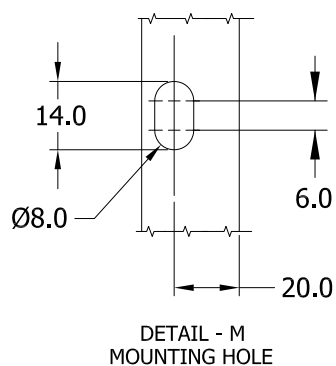
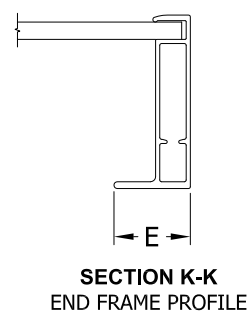
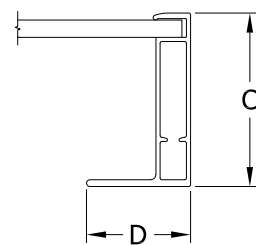
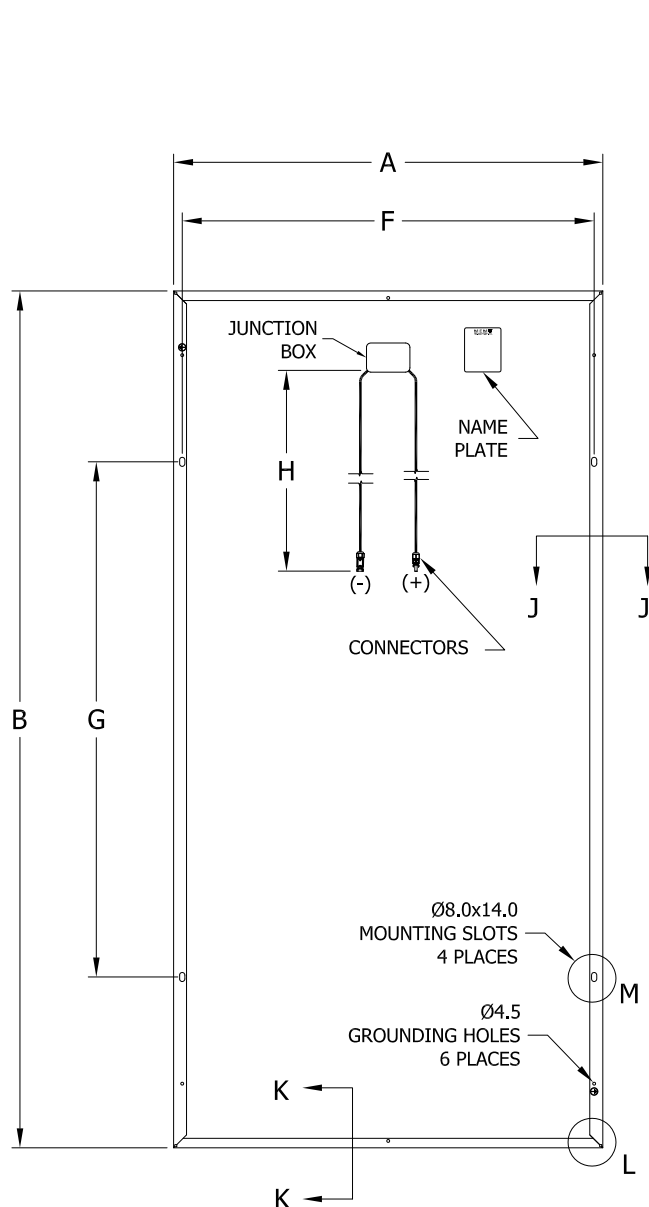
IV CURVES AT MULTIPLE IRRADIANCES [25°C]



IV CURVES AT MULTIPLE TEMPERATURES [1000 W/m²]



performance, reliability, and fire safety codes.



PHYSICAL PARAMETERS

Dimension	MM	INCH
Module Dimensions		
A	990	39.0
B	1,976	77.8
C	50	2.0
D	30	1.2
E	22	0.9

Dimension	MM	INCH
Mounting Hole Spacing		
F	950	37.4
G	1,188	46.8
Cable Length		
H	1,000	39.4

Cable length Tolerance - 2.5 mm + 52.5 mm

Module Weight (kg)	22.2
Frame Material	Anodized Aluminum
Glass (mm)	3.2 Tempered ARC glass

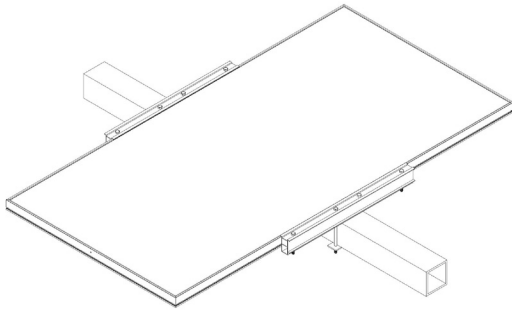
Dimension tolerance range for:
A ±3 mm, B ±3 mm and C ±0.3 mm

Please note: the information in this installation manual is preliminary and subject to change.

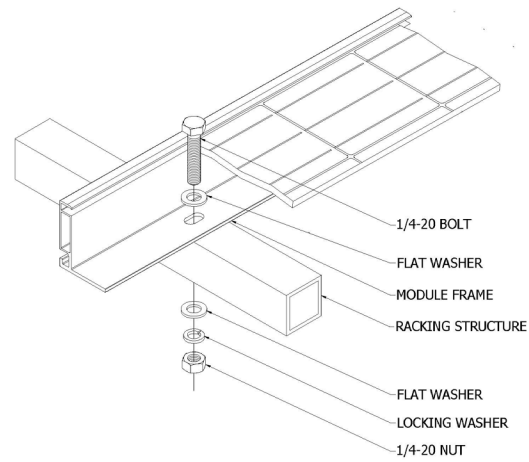
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8.0 APPENDIX

8.2 MODULE ILLUSTRATIONS

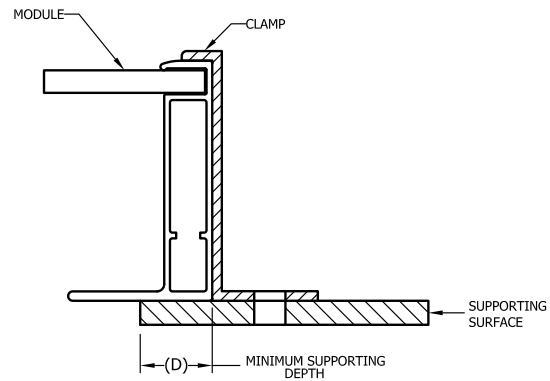
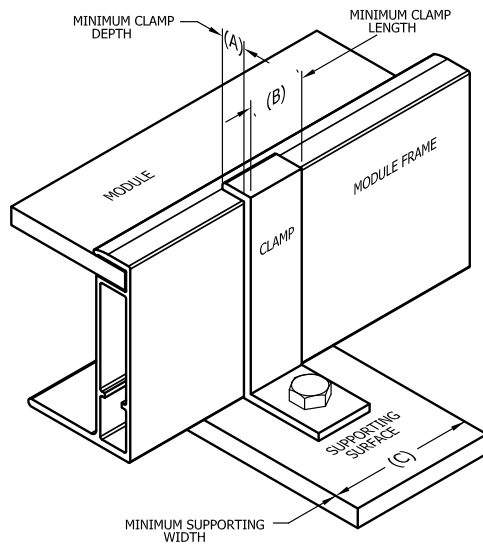


Center Mount Option



Bolt Stack Details

8.3 CLAMP DRAWINGS



Dimension	MM	INCH
Module Clip Dimensions		
A	6.35	0.3
B	38	1.5
Minimum Support Dimensions		
C	15	0.6
D	15	0.6

8.0 APPENDIX

8.4 PRE-MOUNTED CABLES AND CONNECTORS

Mounting Configuration	Pre-mounted cables	Pre-mounted connectors
Manufacturer	BizLink Technologies (http://www.bizlinktech.com/index.html)	
Type	TUV – PV1-F & UL – PV wire	locking polarized connectors*
Cross section	4.0 mm ²	4 mm dia.
Max. current	30 A at 85°C	IEC 25 A and UL 20 A
Max. system voltage	IEC 1000 V DC/ UL 1000 V	IEC 1000 V DC/ UL 1000 V
Temperature rating	-40°C to +90°C	-40°C to +85°C
Qualification	TUV 2PFG & UL PV wire	EN 50521 & UL for PV sys

* (female part no. S418-21B-053; male part no. S418-22B-053)

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